



Advisory Board for  
the Research Councils

**Science and Technology**

Advice to the  
Chancellor of the Duchy of Lancaster

Office of Science and Technology

## **ABRC: TERMS OF REFERENCE AND MEMBERSHIP**

### **TERMS OF REFERENCE**

1. To advise the Chancellor of the Duchy of Lancaster on his responsibilities for civil science - with particular reference to the Research Council system and its articulation with higher education, and the proper balance between national and international scientific activity.
2. To advise the Chancellor of the Duchy of Lancaster on the resource needs of the Research Councils, Royal Society and Royal Academy of Engineering, and on the allocation of the Science Budget between these bodies.
3. To promote effective collaboration between the Research Councils and the harmonisation of their activities, and to advise the Chancellor of the Duchy of Lancaster on any necessary transfers of responsibilities between Councils.
4. To work closely with the Higher Education Funding Councils on issues concerning the support of research in higher education institutions, and the training and support of postgraduate students.
5. To promote effective collaboration between Government Departments and Research Councils in the development of both their forward strategies, and in arrangements for commissioned research.
6. To promote productive interaction between the Research Councils and the users of the research which they support.

### **MEMBERSHIP**

Sir David Phillips KBE FRS	Chairman
Professor Sir Eric Ash CBE FRS FEng	Rector, Imperial College London
Professor T L Blundell FRS	Director General, Agricultural and Food Research Council
Professor D A Currie	Professor of Economics, London Business School
Dr A Ganguly	Director, Research and Engineering, Unilever plc
Professor R L Gardner FRS	Director ICRF Developmental Biology Unit, University of Oxford
Professor M Hart FRS	Professor of Physics, University of Manchester
Professor J L Knill FEng	Chairman, Natural Environment Research Council
Professor H J Newby	Chairman, Economic and Social Research Council
Dr D A Rees FRS	Secretary, Medical Research Council
Sir Mark Richmond ScD FRS	Chairman, Science and Engineering Research Council
Professor I A Shanks FRS	Chief Scientist, Thorn EMI plc
Professor W D P Stewart DSc FRSE FRS*	Chief Scientific Adviser, Cabinet Office
Mr R Dawe*	Deputy Secretary, Department for Education
Dr D G Libby	Secretary

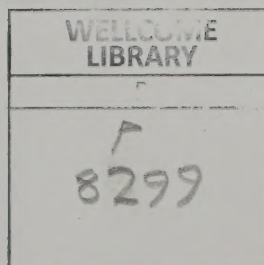
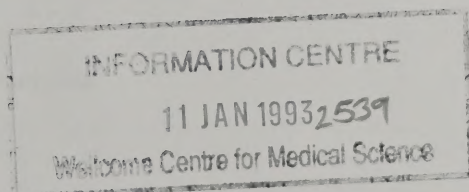
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Advisory Board for the Research Councils

# Science and Technology



Advice to  
the Chancellor of the Duchy of Lancaster



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This response is the consensus view of the  
Advisory Board for the Research Councils  
and, where there has been dissent,  
then the majority view is recorded.





Chairman  
Sir David Phillips KBE FRS

Secretary  
D G Libby

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30 October 1992

*Dear Chancellor,*

**WHITE PAPER ADVICE**

I attach our response to your invitation to advise on the contents of your forthcoming White Paper on Science and Technology.

In our advice we have focussed on what we see as the main issues and what we think should be done about them. We hope that this approach will help the preparation of the White Paper. There are also a number of small points to which I should draw attention.

First, some of our recommendations would require further detailed work before they could be implemented, for example, the reallocation of responsibilities to the Research Councils as part of their restructuring.

Second, in the diagram illustrating our recommended funding and advisory arrangements, we have followed a framework similar to that adopted by ACOST so as to bring out the relationship between our respective approaches.

Third, you will notice the disclaimer on the reverse of the cover sheet. I thought it right to include it, but would stress that nearly all of the recommendations have the unanimous support of Members of the Board.

If you would like me, or the Board, to explain in greater detail the rationale underpinning our position on any of the recommendations, we are at your disposal. Furthermore, I know that the Board would welcome an opportunity to comment on the text of the White Paper before it is finalised, if you thought that would be helpful.

I am copying this submission to Robert Jackson.

*Yours sincerely,*  
*David*

DAVID PHILLIPS





## EXECUTIVE SUMMARY

### INTRODUCTION

1. To maximise the contribution of the science base to the economy and society, there should be greater emphasis on the discovery, development and application of knowledge for public benefit. To help bridge the gap between the science base and industry, the Government should develop and implement a positive strategy for the support of the spectrum of research from basic through to high-risk applied research. (See paragraphs 1-8).

### INTERACTIONS WITH USERS

2. The top priority in science and technology policy should be to improve the interaction between the science base and industry and other users of research, by encouraging the movement of people and ideas among them. (See paragraphs 9-12).

3. The users of research, both within and outside the public sector, should be involved in formulating science policy within Government Departments and within their agencies. To achieve more effective interactions among Government Departments with strong interests in research and development, the science base and other users of research, each Government Department and each Research Council should have a clear statement of its mission, and each Research Council should set up concordats with appropriate Government Departments. (See paragraph 13).

### A scientific culture

4. As the economy is becoming more knowledge- and technology-intensive, greater appreciation of the value of science, engineering and technology to the economy and society as a whole is urgently needed throughout society. To this end, a broad education in science should be provided at an early stage in schools, and the breadth of education maintained throughout the secondary education system, by broadening the present A-level system. It is important that all students appreciate both the excitement of science, and the role that science and technology play in underpinning society and the economy.

5. Culture changes are also needed in both industry and academia. For example, some of the most successful sectors of UK industry enjoy close links with the science base, but there is a large part of UK industry which does not effectively utilize the science base to help solve technological problems and provide technological advances. Moreover, at the same time, within the science base, researchers need to recognize that not only is intellectually demanding work of the highest quality needed to generate new understanding, but also to apply existing knowledge in the pursuit of invention and innovation. (See paragraphs 14-18).

6. One of the Board's main concerns is how to bring about the efficient diffusion and uptake of technology throughout the economy and society more generally. It is not sufficient simply to encourage researchers within the science base to seek out the potential customers for their research. Direct and positive action is needed to encourage all sectors of industry, in particular the small and medium-sized enterprises (SMEs), to seek help and advice from the science base. (See paragraph 19).

## RESEARCH COUNCIL STRUCTURE

7. The changing nature of science and the science base requires the evolution of the Research Council system. The present activities of the Research Councils should be reorganized on a mission-orientated basis, with the whole overseen by a Board for the Research Councils. The primary mission of each Research Council should be:

to respond to the UK's scientific needs by all appropriate means, so as to enhance economic well being and the quality of life.

8. The scientific responsibilities of the present natural science Research Councils should be reorganized as: Biology and Biosphere; Geosphere; Physical and Engineering Sciences; Astronomy and Particle & Nuclear Sciences; Medical Research. A new Research Council should be set up to embrace the functions of the present ESRC and responsibility for the support of research in the humanities. This new body should be called the Social Sciences and Humanities Research Council (SSHRC). (See paragraphs 21-31).

## DELIVERY MECHANISMS

### Higher Education Institutions

9. The research environment in HEIs is crucial to the continuing health of the science base because most of publicly funded science is carried out in these institutions. As a result of the shift in the dual support boundary, the Research Councils now pay for all direct and most indirect costs of the projects that they support in HEIs, although the HEIs retain control of resources for the salaries of permanent academic staff and for the maintenance of research premises. The consequent increase in Research Councils' responsibilities places increased emphasis on the importance of the relationship between the Research Councils and HEIs. Such relationships should lead to a more strategic deployment of funds than the allocation of individual research grants allows.

10. The Research Councils should: establish strategic partnerships with HEIs which will lead to the joint deployment of resources to achieve common objectives; use longer-term support based on evaluation of outputs, rather than short-term support based on a priori assessment; and create a recognized progression of support from grants to rolling programmes to units and other selective, longer-term modes focused on the best scientists and clear scientific strengths. (See paragraphs 33-36).



### Research Council Institutes

11. Research Council Institutes (RCIs) are a small but generally successful part of the science base. They are subject to stringent internal review and evaluation which leads to the clear setting of objectives, prioritisation and, where appropriate, to rigorous programme termination or unit closure. These management procedures should be extended across all publicly funded research agencies and laboratories, and common review criteria and standards of scientific excellence should be applied. (See paragraph 37).

12. Although institutes share many of the characteristics of Next Steps Agencies (NSAs), they also enjoy some important advantages. If they were to become NSAs, we are concerned that they would then be too remote from the science base, that there would be no increase in the efficient and effective use of resources, and that the Research Councils' ability to implement a coherent science and technology strategy would be seriously impaired. (See paragraphs 38-45).

13. NSAs still enjoy close links with their parent Government Department, and many of them carry out underpinning basic research in support of their policy-led research activity. Such basic research is too remote from science base activity to influence scientific development in HEIs and elsewhere, and the effective dissemination of ideas across the publicly funded academic and research system is impeded. There should therefore be a review of the role and affiliations of the Government's scientific agencies, and consideration given to whether some agencies, or some part of them, might be better placed within the remit of the Office of Science and Technology. (See paragraph 49).

### Level Playing Field for all Contracts and Grants

14. Research in HEIs superficially appears to be cheaper than elsewhere because the resources for the salaries of permanent academic staff and the maintenance of research premises are currently provided from the UFC block grant. Significant progress towards a truly level playing field would be achieved by transferring from the Funding Councils to the Research Councils the resources for the research element of academic salaries and for the maintenance of research premises that are attributable to research grants. Whilst we do not consider such a large perturbation of the HE system to be desirable so soon after the recent shift in the dual support boundary, we nonetheless recommend that such a transfer be implemented as soon as practicable. In the meantime, the full economic cost of the research in HEIs should be revealed by displaying the current Funding Council contribution on all HEI research grants and contracts. And we affirm the principle that the full economic cost of HEI research projects should be paid by all customers (industry, charities, Government Departments), thereby creating a level playing field both within the HE system and between the HE system and other research providers (eg Research Council institutes, Government laboratories and industry). (See paragraphs 46,47).



15. If there is to be a level playing field for Government R&D contracts across Government research laboratories, RCIs and HEIs, there must be "reciprocity". Government Departments must be as ready to place contracts with other laboratories - including RCIs and HEIs - as with their own agencies; and Research Councils should accept grant applications from Government laboratories and agencies, where appropriate. (See paragraph 48).

## **SUPPORT OF RESEARCH IN HEIs AND RCIs**

### Market Testing

16. For more effective and efficient use of resources within the science base, all Research Council operations should be market tested. In addition, facilities should be market tested, and options for new management systems, where necessary, should be identified and implemented as soon as possible. Furthermore, the use and support of facilities should be considered in the context of the international network of shared and publicly supported facilities. (See paragraphs 29 and 50).

### European and International Relations

17. International collaboration in the support of facilities and scientific programmes is essential if the UK is to be involved in the increasingly costly challenges at the leading edge of scientific discovery. We believe that there is plenty of scope for the development of national and international plans outwith the aegis of the European Community. But within the European Community, there is a need for improvements in the quality control and for more effective management of EC science and technology programmes. (See paragraphs 51-54).

## **MANPOWER**

18. Highly skilled manpower is one of the most important outputs of the science base. We recognize that, in addition to the high-fliers who have the potential to be research leaders in industry or academia, a cadre of competent, highly skilled "research officers" are essential for the long-term support of research in any environment. We are concerned that little consideration is given to the long-term career development of research-only staff in HEIs, and little responsibility is taken by HEIs for these staff or their future employment.

19. To gain the best results from the Research Councils' investment in research, the Councils should seek assurances from the HEIs about the effectiveness of their personnel policies. When a grant is awarded, the Councils should require HEIs to submit a short statement confirming: that a research assistant (RA) is registered in the institution - with a central record of the grant(s) that the RA is, or has been, working on; details of the appraisal procedures and career counselling that will be provided for the RA - including when in the period of the grant these will be provided, and what form they will take; details of training to be provided - and to what professional qualification the training might lead; and, if the RA is to be

registered for a higher degree, a brief outline of the distinction between the study and normal work programmes.

20. Reciprocally, the Research Councils should collaborate with HEIs in the development of the research base through a variety of mechanisms, and should entertain proposals for the longer-term support of such research staff as have been identified, through appraisal and counselling, as having promise, either as research leaders or research officers. These judgements should also include consideration of the possible careers of these promising scientists in either academia or industry. (See paragraphs 58-60).

## **ADVISORY AND MANAGEMENT STRUCTURES**

### **Coordination**

21. For an effective national strategy, it is essential that a mechanism should be established to look across all Government R&D activity. We consider that this is best done by strengthening the coordinating role of the existing official committee on science and technology: a Science and Technology Coordinating Committee should be established, chaired by the Chief Scientific Adviser, with a secretariat provided by the OST. (See paragraphs 61-64).

### **Advice**

22. At the national level, the Government needs independent advice on the overall pattern of science and technology. The advice should be independent of short-term policy considerations and the pressures of lobby groups and vested interests, and be provided by a group of people with a high level of expertise and experience. A Science and Technology Advisory Committee should be established, which would have a visionary role and be unconstrained by bureaucratic structures. It should identify problem areas in science and technology, and draw attention to opportunities in danger of being overlooked. It would be the responsibility of the Chief Scientific Adviser and OST to take appropriate action on the recommendations of this Committee. (See paragraphs 65-68).

### **Government Departments**

23. Most Government Departments have advisory committees which help them to determine priorities and the activities to be undertaken to address those priorities. The operation of the advisory system is insufficiently well understood; each Department should therefore publish an explanatory review of its advisory structure. Furthermore, to capitalize on the expertise captured in these committees and to improve the exchange of views and ideas, arrangements should be made for regular meetings of members of these Departmental science and technology advisory committees, under the chairmanship of the Chief Scientific Adviser. (See paragraph 69).

## Research Council System

24. The Board for the Research Councils should provide independent advice to the Chancellor of the Duchy of Lancaster on scientific priorities and the balance of funding within the framework of the Government's overall strategy on science and technology. The Board should be responsible for: coordinating Research Council activities; and keeping under review the performance of each Council against its mission. It should provide an Annual Report to the Chancellor of the Duchy of Lancaster, which should be brought before Parliament.

25. The effective function of an advisory Board depends on the use made of the advice it provides. Established mechanisms exist for the handling of the ABRC's formal Advice, supplied at the beginning and end of the Public Expenditure Survey. In contrast, there are no established mechanisms by which the ABRC's conclusions on other science management issues are implemented. To overcome this problem, the Board for the Research Councils should normally transmit its conclusions as formal Advice to the Chancellor of the Duchy of Lancaster. This Advice should either be implemented by the management structure of OST, or returned to the Board along with an explanation of why it is not acceptable to the Government. (See paragraphs 70-73).



# SUMMARY OF RECOMMENDATIONS

	Page number
INTRODUCTION	1
3.1 The Government should have a clear and public policy for the support of science and of technology.	1
7.1 The Government should develop and implement a positive strategy for the support of the spectrum of research from basic through to high-risk applied research and thus help to provide a bridge between the research base and industry.	3
INTERACTIONS WITH USERS	3
10.1 A top priority for national science policy should be to address the interaction, through the movement of knowledge and of people, between the science base and industry and other users of research.	3
11.1 A national technology policy would provide a much-needed strategic framework for the development and fostering of initiatives aimed at local economic and social development.	4
11.2 Regional economic development agencies should provide funding in support of research and development aimed at promoting the economic development of their areas.	4
12.1 Broadly representative customers for research should sit, together with relevant Government departments, on the strategy committees of science base institutions to provide input into the formulation of science and technology policies and to ensure that they take into account the needs of the economy generally.	4
13.1 The mission of each Government Department should be clearly identified, so as to promote more effective interactions among the Government Departments with strong interests in research and development, the science base and other users of research.	4
13.2 The mission of each Research Council should be clearly identified and Councils should establish concordats with appropriate Government Departments.	4
<u>A scientific culture</u>	5
14.1 Science and technology are essential components of modern culture and should form a more significant part of the core curriculum at all levels of the primary and secondary education system. Attention should be paid as much to the harnessing of science as to experimental methodology and original knowledge.	5

14.2	We endorse programmes contributing to the public understanding of science: all scientists and technologists should be involved in the dissemination of scientific awareness.	5
15.1	Funds should be targeted - on a competitive basis - on research teams in HEIs who are embarking on strategic alliances with companies in the private sector.	5
15.2	An incentive fund should be created, drawing on and enhancing available resources, to enable entrepreneurial scientists and engineers to develop and sustain close ties with industry.	6
16.1	There should be better incentives to encourage publicly funded scientists to consider potential applications of their work at all stages of their research and to engage in fundamental research to solve generic technology problems. The rapid and innovative application of new and existing knowledge should be strongly rewarded.	6
17.1	There should be a wider range of graduate training opportunities to meet the strategic needs of the economy and society. The qualifications gained should place more emphasis on: the application of existing knowledge; project management skills; communication skills; and team work. The objective of these schemes should be to service more effectively the demand from individuals for a diversity of career paths, and from labour markets for very highly qualified manpower.	6
18.1	The OST should initiate technology foresight activity involving representatives from industry, the Research Councils and Government Departments. Systematic and consultative procedures should be developed to identify at an emergent stage those areas of research with the greatest technological promise and most likely to yield significant social and/or economic benefits. This information should be used to inform funding decisions.	7
19.1	The work of the DTI Innovation Unit should be developed and extended to promote the identification and adoption of best technology, in particular to encourage SMEs to make use of the science base as a readily accessible resource capable of adding value to their products and processes.	7
19.2	The DTI Innovation Unit should work closely with OST in the development of its technology foresight activity.	7
20.1	The Government should encourage a long-term strategy for European and international research collaborations in order to maximise the contributions of such links to UK society, the economy and the science base.	7
20.2	A new type of clearing house should be set up to improve communication between the UK research organizations and corresponding research funding organizations within Europe, and to help us and EC partner nations concentrate on areas of current and emerging scientific and technological strength.	7

RESEARCH COUNCIL STRUCTURE	8
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<u>Responsibilities of Research Councils</u>	8
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29.1 The present activities of the Research Councils should be reorganized on a mission-orientated basis, with the whole system overseen by a Board for the Research Councils.	10
29.2 The primary mission of the Research Councils should be:	

to respond to the UK's scientific needs by all appropriate means, so as to enhance economic well being and the quality of life.

Detailed outline missions are attached (ANNEX A) and these missions should be regularly reviewed and revised as appropriate, by each Council in consultation with its scientific and user communities and with OST.	10
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29.3 The scientific responsibilities of the present natural science Research Councils should be reorganized as: Biology and Biosphere; Geosphere; Physical and Engineering Sciences; Astronomy and Particle & Nuclear Physics; Medical Research.	10
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29.4 A new body should be established, to embrace the functions of the present ESRC and with extended responsibility for the support of those aspects of research in the humanities not included at present. This new body should be called the Social Sciences and Humanities Research Council (SSHRC). Researchers in the humanities would then, like the natural and social science researchers, have a channel of funding to complement that directed through the UFC/HEFCs. The role and remit of the British Academy should be reviewed and revised so that its activities complement Research Council support for the humanities.	10
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29.5 The Chancellor of the Duchy of Lancaster should appoint representatives of the principal user communities and relevant Government Departments as Members of the Research Councils, with a role to ensure that Councils engage in the appropriate pursuit of their objectives so as best to enable them to fulfil their missions.	10
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29.6 Each Council should, in pursuit of its mission and objectives, develop a characteristic style and structure. Such diversity is appropriate, but it is also desirable that there should be a harmonious and consistent framework of organisational structures for the management of research grants and postgraduate training.	10
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29.7 Each Council should:	
29.7.1 develop and extend the LINK, CASE and Teaching Company schemes, in association with appropriate Government Departments and seek by this and all other means to improve	



- the interaction between the science base and the users of its research;
- 29.7.2 ensure, as an embedded part of all science rather than as a top-down requirement, that research is carried forward to a stage at which it becomes accessible for exploitation, with a view to close collaboration with industry and other users of research;
  - 29.7.3 develop and implement a strategy for manpower training which is responsive to national needs and career opportunities;
  - 29.7.4 support the full range of disciplines appropriate to its mission;
  - 29.7.5 keep under review the health of, and the balance of effort in, the fundamental areas of research which underpin its mission;
  - 29.7.6 support the full spectrum of research, from basic underpinning research to long-term applied research in the knowledge that this will lead to healthy and competitive overlap between Councils in areas of rapid and interdisciplinary development. 10
- 29.8 Each Council should maintain a full range of approaches to promoting, and support for, research activity so as to deliver optimally against its mission. This range should include:
- both short-term and long-term support;
  - both responsive-mode funding and directed programmes established to pursue a particular initiative (eg AIDS);
  - HEI-based, "institute-based" and international programmes.
  - support of research in other agencies when this provides the best opportunity for scientific advance. 11
- 29.9 Each Council, in collaboration with the SSHRC, should support the social and economic science research which is required for the achievement of its mission. 11
- 29.10 Market testing should be extended to all Research Council operations. 11

#### Other funded bodies

- 32.1 To the extent to which the activities of the Royal Society and the Royal Academy of Engineering overlap with the Research Councils' activities, consideration should be given to some overall rationalization. 12
- 32.2 The potential overlap between the activities of the British Academy and the SSHRC should be examined, and consideration should be given to the place of the British Academy within the overall system. 12

DELIVERY MECHANISMS	12
<u>Higher Education Institutions</u>	12
34.1 All HEIs should set up mechanisms to: identify and support a strategy directed at corporate research aims; concentrate research resources on groups and individuals delivering the best research within that strategy; maintain the quality of the research environment; and prevent erosion by protecting research excellence from other institutional pressures.	14
34.2 The present policies of the UFC/HEFCs, directed to the increased identification of and accountability for research resources, should be retained and further developed.	14
35.1 The Research Councils should: establish strategic partnerships with HEIs which will lead to the joint deployment of resources to achieve common objectives; use longer-term support based on evaluation of outputs, rather than short-term support based on <u>a priori</u> assessment; and create a recognized progression of support from grants to rolling programmes and thence to units and other selective, longer term modes focused on the best scientists and clear scientific strengths.	14
36.1 Any future research assessment and management information system should be designed to support continuous rather than periodic review. The information system for research assessment should be common to the Funding Councils and the Research Councils.	14
<u>Research Council Institutes</u>	15
37.1 The rigorous and transparent review process currently employed by the Research Councils for their institutes and units should be extended across all research agencies and laboratories receiving publicly funded grants and contracts, and common review criteria and standards of scientific excellence should be introduced and exercised.	15
44.1 We recommend that RCIs should not be distanced from the science base by becoming NSAs. Such a move would lessen Research Councils' ability to implement a coherent strategy for the support of science and technology, but would lead to no increase in the efficient and effective use of resources.	16
45.1 All RCIs should have a clear mission statement appropriate to and defining the institute's process and activity. The mission statement should be: specific, measurable, realistic and time-bound; set standards and lead to clear performance indicators; make clear the logic of who does what and where; and be endorsed by the staff collectively and individually.	16

- 46.1 Because we do not wish there to be a large perturbation of the HE system so soon after the recent shift in the dual support boundary, we do not recommend that there should at this stage be a transfer of funds in respect of premises and academic staff costs from the Funding Councils to the Research Councils. Such a transfer would, however, provide a route towards a level playing field and should be implemented as soon as practicable. In the meantime, the current Funding Council contribution should be displayed on all HEI research grants and contracts so that the full economic cost of the research is revealed. 17
- 47.1 We affirm the principle that the full economic cost of research projects carried out in HEIs should be paid by all customers (charities, industry, Government Departments) thereby creating a level playing field within the HE system and between the HE system and other research providers including RC institutes, Government laboratories and industry. 17
- 48.1 All customers should be prepared to place contracts with any possible contractor, or give grants to any possible recipient, and must recognize that it is Government policy that HEIs and RCIs should secure full cost recovery. 18
- 48.2 GREs, NSAs and RCIs should be eligible to apply for research grants from the Research Councils. Cross-Council funding and Research Council funding of Government research laboratories should take place wherever it is appropriate in achieving strategic scientific objectives efficiently and effectively. 18
- 49.1 There should be a review of the role and affiliations of the Government's scientific agencies. Government should consider whether some agencies, or some part of them, might be better placed under the aegis of the OST and within the strategic planning framework of the Research Council system (eg the Hadley Centre, the MAFF Fisheries Laboratory at Lowestoft, RSRE, TRRL and the Natural Resources Institute). This would lead to more effective dissemination of ideas and expertise across the publicly funded academic and research system. It would also lead to healthy competition in closely related areas of activity and areas of overlap. 18

SUPPORT FOR RESEARCH IN HEIS AND RCIS 18

Facilities 18

- 50.1 Facilities should be market tested, in the expectation that this will ensure the most effective use of resources. Options for new management systems, where necessary, should be identified and implemented as soon as possible. 19



<u>European and International Relations</u>	19
52.1 Liaison between research teams in different countries should be encouraged as an important part of all scientific programmes, but should be left untrammelled so far as possible by additional bureaucratic structures.	19
52.2 Scientists should understand that it is the responsibility of the Research Councils, and ultimately of Government, to decide whether to fund international collaborative programmes after consideration of scientific priorities. A minimum level of bureaucracy for the administration of these schemes should always be an aim.	19
53.1 The Cabinet Office guidelines should be used as a basis for the discussion of international collaborations between Research Councils and other groups. Particular care should be taken by the Councils to include, at the outset of any negotiation, assessment procedures which match their own internal procedures, as well as possibilities for withdrawal. For collaborations already in place, the UK should press for full scientific evaluation at natural breakpoints in the work before further funds are committed.	19
MANPOWER	20
<u>Postgraduates</u>	20
55.1 A year spent in formal Master's education should be the normal first step for students likely to benefit from additional training. This step should not be a token hurdle. The resultant qualification should be substantive, of value in itself and contribute to the judgment, not least by the student, of whether such training is desirable and, if so, what the nature of that training should be.	20
56.1 There should be a transfer of resources from the Funding Councils to the Research Councils in respect of the research costs involved in the training of postgraduate research students. A careful analysis of these costs will be required before this transfer can be effected.	21
57.1 College fees in respect of postgraduate research students should no longer be paid to those collegiate universities which charge them. The resources involved should be transferred from the Research Councils to the HEFCs and allocated by the latter as appropriate to the universities concerned.	21

- 60.1 To ensure that the Research Councils gain the best results from their investment in research, they should seek assurances from HEIs about the effectiveness of their personnel policies. 21
- 60.2 The Research Councils should require HEIs to submit a short statement, when a grant is awarded, confirming:
- that an RA is registered in the institution - with a central record of the grant(s) that the RA is, or has been, working on;
  - details of the appraisal procedures and career counselling that will be provided for the RA - including when in the period of the grant these will be provided, and what form they will take;
  - details of training to be provided - and to what professional qualification the training might lead;
  - and, if the RA is to be registered for a higher degree, a brief outline of the distinction between the study and work programmes. 22
- 60.3 Reciprocally, the Research Councils should collaborate with HEIs in the development of the research base through a variety of mechanisms, and should entertain proposals for the longer-term support of such research staff as have been identified, through appraisal and counselling, as having promise, either as research leaders or research officers. These judgements should also include consideration of the possible careers of these promising scientists in either academia or industry. 22

## ADVISORY AND MANAGEMENT STRUCTURES 22

### Coordination 22

- 62.1 We recommend the establishment of a Science and Technology Coordinating Committee (STCC). 23

### Advice 23

- 65.1 Advice on the overall pattern of science and technology should be secured through a top-level Science and Technology Advisory Committee (STAC), reporting to the Prime Minister through the Chancellor of the Duchy of Lancaster. Both Ministers should periodically attend the committee. 23
- 65.2 STAC should have a visionary role and should operate with the minimum of bureaucracy. 23
- 65.3 STAC should identify problem areas and draw attention to opportunities in science and technology which are in danger of being overlooked. 23

## Government Departments

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- 69.1 To aid understanding of the overall pattern of advice which lies behind the development of Government research and development, each Department should publish an explanatory review of its advisory structure, showing: the ways in which this leads to decisions about expenditure and about which programmes are supported; how the Department as proxy customer determines the needs of the ultimate customers; and the interaction between the Department and its contractors. 24
- 69.2 To exchange views and ideas, arrangements should be made for regular meetings of members of these Departmental science and technology advisory structures, under the chairmanship of the Chief Scientific Adviser. 24

## The Research Council system

24

- 72.1 There should be a Board for the Research Councils which should provide independent advice to the Chancellor of the Duchy of Lancaster on scientific priorities and the balance of funding within the framework of Government's overall strategy on science and technology. 25
- 72.2 The Board for the Research Councils should normally transmit its conclusions, as formal Advice, to the Chancellor of the Duchy of Lancaster. Such advice should either be implemented by the management structure of OST or returned to the Board with a clear statement explaining why it cannot be accepted. 25
- 72.3 The Board should coordinate the scientific activities of the Councils, and be responsible for keeping under review the performance of the Councils against their missions. It should provide an Annual Report to the Chancellor of the Duchy of Lancaster, which should be brought before Parliament. 25
- 72.4 There should be regular meetings of the Board for the Research Councils with the Royal Society and the Royal Academy of Engineering to consider how they propose to spend their portions of the Science Budget and how they have spent it, and also meetings with these bodies and the British Academy to consult them about science and technology issues in which they have an interest. 25
- 72.5 The Board should be responsible for close liaison with all the national Funding Councils, who would be represented individually at meetings when business required it. 26
- 72.6 The Board should follow the practice of the present ABRC in maintaining close liaison with the Chief Scientists of Government Departments through regular joint meetings to discuss scientific priorities, areas of common interest and the Departments' interface with the Research Councils. 26



73.1 Consideration should be given to enlarging the scope of the Board, as a Board for Research, to reflect the wider responsibilities of the OST as they develop.

26

The real and legitimate goal of the sciences is the endowment of human life with new inventions and riches - Francis Bacon

## INTRODUCTION

1. The science base is a strategic national resource. It is a source of highly trained and skilled manpower who can develop applications that will increase prosperity and enhance the quality of life. It leads to the development of the national skills base. It provides solutions to technology problems and adds value to the products of industry. And it is a source of discoveries and innovation. The increasing dependence of the economy on technology puts ever greater emphasis on the currency and quality of the science base and on the provision of highly trained manpower to underpin industrial competitiveness.

2. The ABRC believes that it is important to support fundamental science as well as science aimed at application: nothing that follows should be seen as detracting from that belief. Nevertheless, we believe that the balance of emphasis has not been correct and that more attention should be given to the exciting challenge of discovering, developing and applying knowledge for public benefit.

3. Science and technology must be used effectively and efficiently if we are to maximise the contribution of the science base (that is, the Higher Education and Research Council systems): to society; to the quality of life; and to the health of the economy. The Government should ensure that publicly funded science is properly managed and properly used. It therefore needs to develop and implement a policy for science and technology, founded firmly on a policy of integrated economic development and understood by all those engaged in its implementation. The creation of an Office of Science and Technology (OST, within an Office of Public Service and Science - OPSS) provides a central focus for the development of such a policy.

### **3.1 The Government should have a clear and public policy for the support of science and of technology.**

4. To provide a context for our recommendations, we first set out some principles and define our terms. We believe that the failure clearly to understand that science, engineering and technology are linked in a complex, interactive network is one of the problems which has constrained the UK's industrial effectiveness hitherto. Too many people have assumed a simple or linear model in which original ideas which spring from basic, curiosity driven research are taken up in purposive or strategic research which in turn leads to the identification of specific applications and thence to product and process development. Technology is seen to interact with this process only at the later stages but is then variously invoked as a synonym for technique, as a concept, as a process or as a set of competencies. Technology is not itself seen as a driver.

5. We prefer the definition of technology recently proposed by Robert Malpas in his pamphlet on "Technology - Science - Engineering" (October 1992), and these are the definitions which we shall use.

Technology is the result of harnessing all knowledge and experience to produce something practical and commercially useful - a product, a manufacturing process, a system, a service, a methodology.

Science is the main constituent of the knowledge input to technology.

The engineer and engineering are the main profession and discipline involved in technology.

Malpas argues that the market drive to increase industrial competitiveness frequently causes technology to run ahead of scientific knowledge, because things can be done without precise knowledge of how or why they work. But good technologists also know that greater benefits come through improved understanding and so they refer problems to the scientist to solve the "how and why". And, at the same time, developments in technology (eg computing) often facilitate advances in science.

6. We recognise, and would wish others to appreciate, a greater complexity to basic, strategic and applied research than the linear model can encompass. A model which invokes a one dimensional series is attractively simple and extremely deceptive. We do not believe that it is feasible, nor would it be particularly profitable, to try to distinguish absolute research categories as if they were steps in a reaction. If basic research is solely curiosity driven then it becomes strategic the moment a possible relevance, however remote, can be envisaged. Our experience tells us that remarkably little of the work supported by the Science Budget can be defined as "basic" in this way. On the other hand, we see many examples of research output which underpins our fundamental understanding of biology and physics and which has been stimulated by problems arising from applications elsewhere. Two hundred years ago, the exploitation of the steam engine preceded an understanding of thermodynamics by more than half a century; warm superconductors set scientists a similar challenge today.

7. There has, to the detriment of science and technology in the UK, been too much confusion about applied research and product development. Research necessary to bring ideas to the stage where they are accessible for exploitation and application by industry and other research users can be long-term, speculative and expensive. Much, and probably the bulk, of applied research spawns generic or pervasive technologies which benefit a variety of companies in different sectors. Because such research is not uniquely relevant to a specific product or process, industry is understandably reluctant to invest where it cannot guarantee that it will capture all the benefits. For these reasons, the market alone does not lead to adequate support of applied research across all sectors. Specific product development, by contrast, is so market orientated that it is clearly the responsibility of the particular industry which can assess the market, respond to it and profit by that response. While we agree that the development of particular products and processes is for industry to



fund and public funds should not be so employed, we also believe that a false "near market" concept has been used damagingly to constrain the public support of applied research which has caused the failure of carry-through from excellent research potential into something which can properly attract industrial support.

**7.1 The Government should develop and implement a positive strategy for the support of the spectrum of research from basic through to high-risk applied research and thus help to provide a bridge between the research base and industry.**

8. The policy for science and technology which we recommend will require a more detailed statement of the Government's objectives, which we expect the Chancellor to cover in his forthcoming White Paper. We set out below our recommendations on some key areas, including: the interaction of the science base with the users of research and scientific manpower; the coordination and interaction of the publicly funded research base; the Research Council system; Higher Education Institutions (HEIs); manpower training; and international issues in supporting research. We believe the aim of the White Paper should be to develop a coherent strategy for scientific support and for technology, rather than a proliferation of disparate ad hoc schemes.

## **INTERACTIONS WITH USERS**

9. The UK has a scientifically successful science base but, despite the increasing significance of science and technology to industry, the success of the science base has not led to a strong economy. Social and economic benefits come not from having or owning knowledge but from using it: that is, not from science but from technology. For this reason, all developed and developing countries appreciate the value of a scientifically trained workforce and indigenous technical skills. The normal practices of science - open publication in the scientific literature, conferences, the movement of scientists between countries and within internationally collaborative research programmes - all ensure the rapid dissemination of scientific knowledge and discoveries. Scientists and engineers in the public and private sectors then have an important role to play in assessing, filtering and interpreting this knowledge so as to apply it to specific needs.

10. For the UK to enjoy the full benefit of research outputs not only from its own science base but also from other countries, it is important that channels of communication between scientists engaged in basic, strategic and applied research - whether in industry or the science base - and between them and engineers engaged in technology, should not be impeded. The movement of people between these areas of activity should be encouraged.

**10.1 A top priority for national science policy should be to address the interaction, through the movement of knowledge and of people, between the science base and industry and other users of research.**

11. Industrial success is sustained through a highly localized process: local networks of industry, educational institutions and a skilled labour force. The most fertile environment for success is one which is forward-looking, dynamic and challenging. Because of this, the regional economic development agencies in Scotland and Wales play an important role in strategic support of local activity networks which underpin the health and development of the regional economy. A strategy for such focused support could be applied in all regions. Science and technology should form a key part of this strategy and, selectively supported, would provide a bridge between the research base and industry.

**11.1 A national technology policy would provide a much-needed strategic framework for the development and fostering of initiatives aimed at local economic and social development.**

**11.2 Regional economic development agencies should provide funding in support of research and development aimed at promoting the economic development of their areas.**

12. For the successful implementation of an overall science and technology policy, it is important that the science base develops strong interactive contacts with the real users of research where these lie outside the control of Government Departments, as they usually do. It is essential when developing strategies, setting priorities or encouraging scientific developments that national and industrial needs are considered and given due weight.

**12.1 Broadly representative customers for research should sit, together with relevant Government departments, on the strategy committees of science base institutions to provide input into the formulation of science and technology policies and to ensure that they take into account the needs of the economy generally.**

13. Industrial and other users of research in and outside the public sector should also be involved in formulating science policy within Government Departments and within their agencies. To improve the interaction between providers and supporters of research, it is desirable that the public generally should have a clear understanding of the purpose of each Government Department. The dissemination of explanatory mission statements would, we believe, provide an important and useful clarification of these purposes. Indeed, the development and publication of a mission statement should be required of all publicly funded bodies and agencies.

**13.1 The mission of each Government Department should be clearly identified, so as to promote more effective interactions among the Government Departments with strong interests in research and development, the science base and other users of research.**

**13.2 The mission of each Research Council should be clearly identified and Councils should establish concordats with appropriate Government Departments.**

## A scientific culture

14. There should be a positive cultural attitude towards science and industry at all levels in society. It has long been recognised that there is in fact a broadly unsympathetic attitude in the UK towards both activities and that, in many sectors, the two are culturally distant. Yet science is the key to change, innovation and industrial competitive advantage and is in turn stimulated by technological and market demand. Thus, when the pace of technology is rising, this persisting cultural divide is to the great detriment of the economy and society as a whole. We need to couple the two communities and, below, we suggest specific measures to address this issue within the science base and across industry. But such measures will realise their potential only if there are changes at a more fundamental level in the primary and secondary education system. Science should be studied widely and at an early stage in schools, to steep children in as exciting and thorough a scientific culture as for any other subject; the breadth of education should be maintained throughout the secondary system, through a beneficial broadening of the present A-level system; and all students should understand the role that science and technology play in underpinning modern society and the economy.

**14.1 Science and technology are essential components of modern culture and should form a more significant part of the core curriculum at all levels of the primary and secondary education system. Attention should be paid as much to the harnessing of science as to experimental methodology and original knowledge.**

**14.2 We endorse programmes contributing to the public understanding of science: all scientists and technologists should be involved in the dissemination of scientific awareness.**

15. Some of the most successful sectors of UK industry have close links with the science base. Such interactions are not a philanthropic exercise for industry: they are a key part of a successful company's survival strategy. At present, however, a large part of industry still lacks any mechanism to support a fruitful interaction with the science base. More of industry should therefore be enabled to take advantage of the science base in harnessing knowledge and experience to solve problems and pursue the goal of innovation. We have identified several measures which we believe would, if developed along the lines we suggest and carefully thought through, encourage the necessary cultural changes. In our view, these should form the core of any "Faraday" programme. By gearing up resources in this way, scientific expertise would be better used in the improvement and refining of processes; novel, advanced or enabling methodologies would be brought more readily to the attention of industry; and industrially relevant expertise would be developed in universities.

**15.1 Funds should be targeted - on a competitive basis - on research teams in HEIs who are embarking on strategic alliances with companies in the private sector.**



**15.2 An incentive fund should be created, drawing on and enhancing available resources, to enable entrepreneurial scientists and engineers to develop and sustain close ties with industry.**

16. There is a need for a culture change within the UK science base. Academic researchers should recognise that intellectually demanding work of the highest quality is needed not only to generate new understanding but also to engage in invention and innovation, using existing knowledge as elements in the process of creation and synthesis. The LINK scheme shows that partnerships for innovation between industry and academia can be very successful. Industry can be a source of financial support for academic research, but it is also a source of ideas and of problems demanding solutions which will only emerge from original research. Scientists should foster partnerships in which they can pursue knowledge, and contribute fundamentally to technology. But they should also be able to expect appropriate reward for the contribution that they make.

**16.1 There should be better incentives to encourage publicly funded scientists to consider potential applications of their work at all stages of their research and to engage in fundamental research to solve generic technology problems. The rapid and innovative application of new and existing knowledge should be strongly rewarded.**

17. HEIs play a key part in shaping the attitude of science graduates towards their own role in society and the place of scientific research, but a broader development of postgraduate training opportunities is required. CASE studentships are a well established part of the system. The DTI and SERC have recently launched a pilot scheme for postgraduates jointly based at HEIs and industrial research organizations. SERC have also established the "Parnaby" scheme for engineering doctorates. These schemes are aimed at promoting the desired culture change. By exposing the potential value to the economy and society of the innovative application of existing knowledge, in addition to the traditional emphasis on the academic value of original research, this scheme will help to communicate the importance and excitement of technology to young researchers.

**17.1 There should be a wider range of graduate training opportunities to meet the strategic needs of the economy and society. The qualifications gained should place more emphasis on: the application of existing knowledge; project management skills; communication skills; and team work. The objective of these schemes should be to service more effectively the demand from individuals for a diversity of career paths, and from labour markets for very highly qualified manpower.**

18. The creation of a cohort of highly skilled manpower will not of itself serve the nation's perceived social and economic needs. In recent months a worldwide debate has sprung up about the significance of a nation's industrial policy to the enhancement of its business competitiveness. But competitiveness also depends on responsiveness. The Board believes that, in order to be well placed to secure economic prosperity and social progress, an early recognition is required of the most

promising areas in science and technology on which to target funds. This will help to identify priorities for funding bodies.

**18.1 The OST should initiate technology foresight activity involving representatives from industry, the Research Councils and Government Departments. Systematic and consultative procedures should be developed to identify at an emergent stage those areas of research with the greatest technological promise and most likely to yield significant social and/or economic benefits. This information should be used to inform funding decisions.**

19. We cannot emphasize too strongly that one of our main concerns is the efficient diffusion and uptake of best technology throughout the economy generally. It is not enough to encourage the science base to seek out potential users of their research. Direct and positive action also needs to be taken to encourage industry, particularly small and medium sized enterprises (SMEs), in all industrial sectors, to seek help and advice from the science base.

**19.1 The work of the DTI Innovation Unit should be developed and extended to promote the identification and adoption of best technology, in particular to encourage SMEs to make use of the science base as a readily accessible resource capable of adding value to their products and processes.**

**19.2 The DTI Innovation Unit should work closely with OST in the development of its technology foresight activity.**

20. No country can achieve excellence in everything, and the UK does less than 5% of the world's research. Nevertheless, we need to maintain a presence in those areas to which the UK does not attach the highest priority, so as to maintain the UK's capacity to react to scientific developments and to participate in emerging debates. We believe that international collaboration will be essential in enabling UK participation in such disciplines. Direct liaison should be encouraged between national funding agencies so that relative strengths and weaknesses are identified and can be taken into account. The European Science Foundation has an overview of scientific activity in Europe and thus might, with some considerable restructuring, form the basis of an organization for this purpose. Science and technology links should be selectively nurtured, taking account of: likely trends in socio-economic needs and demands for research; the country's internal strengths and weaknesses in R&D; its relative international standing across strategic fields; and the domestic capacity to exploit, commercially or otherwise, the results of promising research.

**20.1 The Government should encourage a long-term strategy for European and international research collaborations in order to maximise the contributions of such links to UK society, the economy and the science base.**

**20.2 A new type of clearing house should be set up to improve communication between the UK research organizations and corresponding research funding organizations within Europe, and to help us and EC**

**partner nations concentrate on areas of current and emerging scientific and technological strength.**

## **RESEARCH COUNCIL STRUCTURE**

21. The present Research Council system must evolve to take into account: the inherently dynamic nature of science and technology; the increasingly pervasive nature of the products of research; increasing interdisciplinarity; the diversity of its users; the complexity of the relationship between research and related economic and social benefits; and the importance to the whole economy of training in scientific research. More flexible structures are needed in order to accommodate and adjust easily to the continually changing character of the science base and its application to the needs of society and industry.

22. Independent Research Councils operate within boundaries set by their individual charters and, in consequence, the present system has sometimes appeared inflexible. These constraints are of particular concern in areas of common interest and we believe they are better handled collectively. Areas of concern include: the training of scientific manpower (number and kind of scientists required, balance between supply and demand, etc.); the balance of effort in research areas such as biology, which are supported by more than one Research Council; and collaboration between Research Councils in fields where joint projects have been initiated. Moreover, the growth of formal international collaborations requires close coordination of Research Councils' policies.

23. Confronted by these problems, the Board has considered whether or not it would be appropriate to recommend a complete restructuring of the present Research Council system. In particular, we have discussed the option of replacing the present multiple system with a single Research Council within which the full spectrum of science activity might be reorganised into a number of operating divisions, each with a clear mission and managed in a highly devolved way by an executive Board. There was strong support within the ABRC in support of this option, but it was strongly opposed by the majority of Heads of Research Councils. The Board has therefore not agreed to recommend a change of this kind. We do believe, however, that a substantial reorganisation of the Councils' responsibilities is timely.

### Responsibilities of Research Councils

24. Inevitably, problems of coordination arise from time to time at the boundaries between bodies responsible for supporting different areas of research. Often this is a consequence of the increasing pervasiveness and interdisciplinarity of the underpinning science. For the purposes of efficient management, however, the spectrum of activity must be divided into a number of separate parts, which can be assigned to appropriate managing bodies. In general, boundaries are best drawn



around areas between which there is least interaction. Each body or division should be responsible for a field of activity which is both homogeneous in nature and manageable in scope. Sub-divisions of scientific activity include:

disciplines (eg biology, physics, engineering, economics);

the nature of the activity (eg basic research, applied research, etc.); and

missions (eg health care, food quality, environmental protection).

25. Disciplines. The boundaries between the traditional core disciplines in science are blurred by the increasing interdisciplinarity of leading-edge research, and this suggests that classifying activity by discipline would be a retrograde step.

26. The nature of the activity. It is important that interactions between basic, applied and strategic research should not be impeded, and that there should not be any obstacle, such as an artificial division or boundary, to movement of people between these areas of activity. This argument makes a classification by activity type less than desirable if the objectives are to enable research to evolve quickly and effectively to the point at which it can be applied and to employ scientifically trained manpower to the best advantage for the nation and the economy.

27. Missions. These provide a purposeful focus and define objectives without demarcation of disciplines or activities. A mission allows the pursuit of the range of disciplines appropriate to its achievement and allows basic or underpinning research to be closely associated with that which is strategic or mission-orientated. Significantly, in the present system the AFRC, the MRC and the NERC (all mission-orientated councils) regard themselves as responsible for the basic research underpinning each of their missions.

28. The establishment of entirely mission-orientated Research Councils should help to bring about a culture change whereby the complex relationship between science, engineering and technology is clearly recognized, and the conventional, rather rigid, categorization of research (basic, strategic, applied and "near-market") and development is relaxed. In the management of science, it must be recognized that the development of important technologies may often require as much long-term speculative investment as the solution of long-standing scientific problems. Applied research may fail for lack of basic understanding, while successful basic research can immediately display potential application.

29. A mission is valuable because: it is a powerful stimulus to progress in the basic sciences; it provides the incentive for establishing the necessary contacts and alliances for exploiting and applying the outputs of the science base - with industry, the Government Departments, the NHS etc.; and the performance of each mission-orientated body can be assessed against its mission.

29.1 The present activities of the Research Councils should be reorganized on a mission-orientated basis, with the whole system overseen by a Board for the Research Councils.

29.2 The primary mission of the Research Councils should be:

to respond to the UK's scientific needs by all appropriate means, so as to enhance economic well being and the quality of life.

Detailed outline missions are attached (ANNEX A) and these missions should be regularly reviewed and revised as appropriate, by each Council in consultation with its scientific and user communities and with OST.

29.3 The scientific responsibilities of the present natural science Research Councils should be reorganized as: Biology and Biosphere; Geosphere; Physical and Engineering Sciences; Astronomy and Particle & Nuclear Physics; Medical Research.

29.4 A new body should be established, to embrace the functions of the present ESRC and with extended responsibility for the support of those aspects of research in the humanities not included at present. This new body should be called the Social Sciences and Humanities Research Council (SSHRC). Researchers in the humanities would then, like the natural and social science researchers, have a channel of funding to complement that directed through the UFC/HEFCs. The role and remit of the British Academy should be reviewed and revised so that its activities complement Research Council support for the humanities.

29.5 The Chancellor of the Duchy of Lancaster should appoint representatives of the principal user communities and relevant Government Departments as Members of the Research Councils, with a role to ensure that Councils engage in the appropriate pursuit of their objectives so as best to enable them to fulfil their missions.

29.6 Each Council should, in pursuit of its mission and objectives, develop a characteristic style and structure. Such diversity is appropriate, but it is also desirable that there should be a harmonious and consistent framework of organisational structures for the management of research grants and postgraduate training.

29.7 Each Council should:

29.7.1 develop and extend the LINK, CASE and Teaching Company schemes, in association with appropriate Government Departments and seek by this and all other means to improve the interaction between the science base and the users of its research;

29.7.2 ensure, as an embedded part of all science rather than as a top-down requirement, that research is carried forward to a stage at which it becomes accessible for exploitation, with a view to close collaboration with industry and other users of research;

29.7.3 develop and implement a strategy for manpower training which is responsive to national needs and career opportunities;

29.7.4 support the full range of disciplines appropriate to its mission;

29.7.5 keep under review the health of, and the balance of effort in, the fundamental areas of research which underpin its mission;

29.7.6 support the full spectrum of research, from basic underpinning research to long-term applied research in the knowledge that this will lead to healthy and competitive overlap between Councils in areas of rapid and interdisciplinary development.

29.8 Each Council should maintain a full range of approaches to promoting, and support for, research activity so as to deliver optimally against its mission. This range should include:

- both short-term and long-term support;
- both responsive-mode funding and directed programmes established to pursue a particular initiative (eg AIDS);
- HEI-based, "institute-based" and international programmes.
- support of research in other agencies when this provides the best opportunity for scientific advance.

29.9 Each Council, in collaboration with the SSHRC, should support the social and economic science research which is required for the achievement of its mission.

29.10 Market testing should be extended to all Research Council operations.

30. The grouping of astronomy, planetary science and particle & nuclear physics would bring together "big" science activities and those research areas which depend upon the development of advanced technologies which are of widespread utility even though direct applications of the research results are perhaps rather remote. It would allow areas of similar nature to be compared with each other when setting priorities; the deployment of the substantial resources in these areas could be considered and prioritised against activity across the whole of the science base, rather than against that within one Council; and areas in which there are strong political and diplomatic interests would be clearly distinguished, for wider discussion in Government. The Government may also wish to consider whether the



UK's fusion programme would be best managed by location within this Research Council's structure.

31. Any reorganization of the present Research Council system would require detailed work to enable the consequential restructuring of Board and Committee responsibilities and the reorganisation of institutes and facilities. It should therefore be expected that a cost-benefit analysis would be carried out to examine the interfaces eliminated and created by proposed changes, the frictional costs of the transition and the benefits that would be obtained.

### Other funded bodies

32. The other bodies funded from the Science Budget - the Royal Society and the Royal Academy of Engineering - have an important role in representing and supporting the scientific and engineering community. They are also active in promoting excellence in science and technology, by: championing public understanding; creating opportunities for highly talented young people to undertake their own research in HEIs; supporting excellent individuals through the award of research professorships; and promoting international relations, eg by individual exchanges of scientists and engineers. These activities generally complement those of the Research Councils and warrant Government support, but the development of activity in some areas has given rise to overlap and - in some instances - a little confusion about roles. The aims of the Royal Society and the Royal Academy of Engineering are attached (ANNEX B).

**32.1 To the extent to which the activities of the Royal Society and the Royal Academy of Engineering overlap with the Research Councils' activities, consideration should be given to some overall rationalization.**

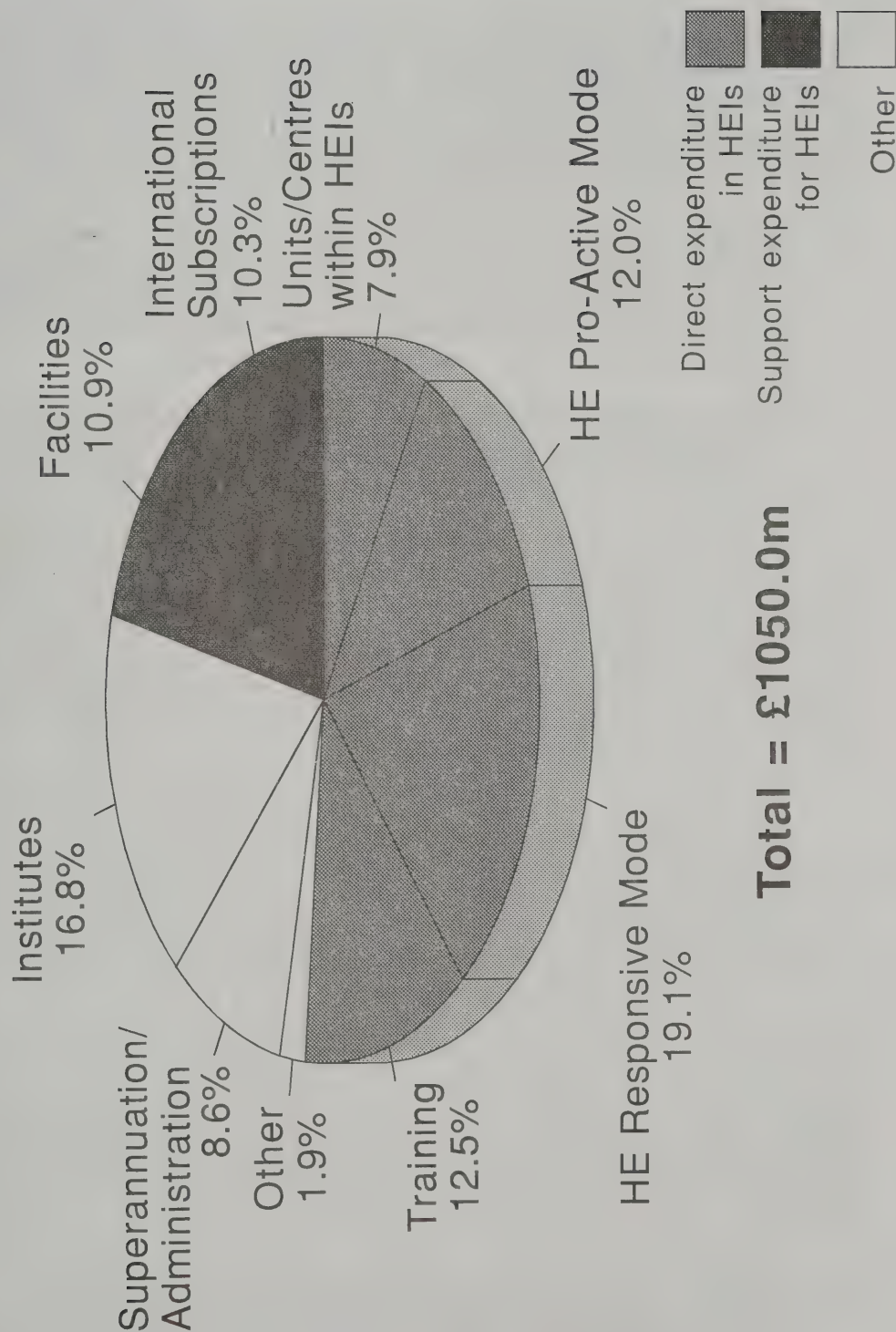
**32.2 The potential overlap between the activities of the British Academy and the SSHRC should be examined, and consideration should be given to the place of the British Academy within the overall system.**

## **DELIVERY MECHANISMS**

### Higher Education Institutions

33. Most publicly funded science is carried out in HEIs, which institutions deliver much of the trained manpower and a large part of the non-commercial research that underpins the national scientific effort. They also undertake contract research for public agencies and for industry. The research environment in HEIs is consequently crucial to the continuing health of the national science base, but the HEIs are changing in ways which impose important new demands on both the customers and contractors of research.

# Science Budget: by mode (1992-93)



34. The shift in the dual support boundary has increased the responsibilities of the Research Councils, who now pay for all direct and most indirect costs of the projects which they support, but the HEIs retain control of resources for the maintenance of the research laboratories and for the salaries of the permanent academic staff. Because of this, the Research Councils will need to be assured that the HEIs have adequate mechanisms in place to manage research support.

**34.1 All HEIs should set up mechanisms to: identify and support a strategy directed at corporate research aims; concentrate research resources on groups and individuals delivering the best research within that strategy; maintain the quality of the research environment; and prevent erosion by protecting research excellence from other institutional pressures.**

**34.2 The present policies of the UFC/HEFCs, directed to the increased identification of and accountability for research resources, should be retained and further developed.**

35. The joint objectives of the Research Councils and the HEIs should be: to foster mechanisms to support the most talented individuals wherever they work; to protect excellent work in small or isolated departments; and to identify and foster new and promising areas of science wherever they appear. The Research Councils will be able to establish a new relationship with those HEIs which have sufficiently strong management mechanisms in place to add value to the joint deployment of resources. Such relationships should lead to a more strategic deployment of funds than the allocation of individual research grants allows.

**35.1 The Research Councils should: establish strategic partnerships with HEIs which will lead to the joint deployment of resources to achieve common objectives; use longer-term support based on evaluation of outputs, rather than short-term support based on a priori assessment; and create a recognized progression of support from grants to rolling programmes and thence to units and other selective, longer term modes focused on the best scientists and clear scientific strengths.**

36. Much information which the Research Councils will in future need, eg about the research management and capability of HEIs, is already collected by the Funding Councils through the research assessment exercise (RAE). The research assessment system is at present less than optimal, however, because of its intermittent nature. We believe that a more effective system would be based on regular, preferably annual or continuous, monitoring as a normal part of updating management information.

**36.1 Any future research assessment and management information system should be designed to support continuous rather than periodic review. The information system for research assessment should be common to the Funding Councils and the Research Councils.**



## Research Council Institutes

37. Research Council Institutes (RCIs) are one of the instruments available to the Research Councils in their support of science, and are a generally successful part of the activity of the science base. They have an essential role in the delivery of scientific research, particularly in areas of scientific activity which are mission-orientated. They are characterized by longer-term scientific planning and closer management than is usual in HEIs. If properly managed, they provide an important complement to HEI-based research and are best located in an HEI environment. Their management incorporates stringent internal review and evaluation which leads to clear setting of objectives, prioritisation and, where appropriate, to rigorous programme termination or unit closure. This provides a good model for wider application.

**37.1 The rigorous and transparent review process currently employed by the Research Councils for their institutes and units should be extended across all research agencies and laboratories receiving publicly funded grants and contracts, and common review criteria and standards of scientific excellence should be introduced and exercised.**

38. Comparisons have been drawn between RCIs and the establishments previously managed by Government Departments. The suggestion has been made that the RCIs might be appropriate bodies for management as Next Steps Agencies (NSAs). There is no blueprint for NSAs, but there are a number of underlying principles which they are expected to have in common. These include: clear mission statements; delegated authority for budgets and staffing; local personnel management, including negotiating pay levels; service delivery in a policy context set by the "parent" body; and the opportunity to contribute to policy development.

39. Financial planning for the RCIs, by contrast, usually involves the Council and Central Office of a Research Council, particularly with regard to buildings and large pieces of equipment which would drain the budgets of individual institutes. For similar reasons, the centre has to plan staff restructuring and fund redundancy payments which also affect institutes in an uneven way. If the problems of "lumpy" investment in capital and staff were not dealt with centrally, an imbalance of resources could result and scientific opportunities would then be missed.

40. Other than at strategic levels, however, the management of agreed annual budgets is fully delegated to institutes. As a consequence of this devolution of responsibility, Research Council Institutes enjoy managerial freedoms and benefits which exceed those of the NSAs. For example, some RCIs are companies limited by guarantee, some are linked to independent foundations. Their charitable status confers important and desirable financial benefits. For example, institutes are encouraged to maximise their R&D earnings, and are able to plan on the basis of retaining such income in full, without any loss of grant or surrender of income. The devolution of responsibilities to the RCIs has necessitated an increasingly professional approach to scientific, financial, personnel and estate management.

41. Devolved management control of RCIs, combined with clear financial monitoring by the Research Councils, provides a clear benefit because institutes can be used strategically to tackle major scientific problems by creating a critical interdisciplinary mass and a concentration of investment. As a tool, the institute mode of supporting research provides particularly important opportunities for the development of:

strategic science programmes integrated across a Council's mission area;

managed redirection to consolidate innovative gains (originating in HEIs and RCIs); and

a balanced response to social, political and intellectual demands.

42. In institutes it is possible for researchers to concentrate full-time on long-term research programmes, and this creates a special culture and commitment to research which is rarely possible in an HEI. There is the capacity to concentrate effort in identified fields, to organize continuing programmes of research in those fields, to focus on the relevance of research to applications, and to mobilize scientists across a range of disciplines. They allow the maintenance of a national capability so that expertise can be focused in response to a policy question (eg bovine spongiform encephalopathy).

43. The relationship between a Research Council and the institutes it manages does not lead to a bias in funding. Planning mechanisms, such as research and strategy committees, ensure that at a strategic level the balance of the different modes of supporting research (through institutes, units in HEIs, programme grants and project grants) is to the overall benefit of scientific excellence and productivity. Furthermore, the highly competitive appraisal of grant applications ensures that the best scientists are supported wherever they may be.

44. It is clear that, while they share many of the characteristics of NSAs, the RCIs enjoy important advantages which the NSAs do not share.

**44.1 We recommend that RCIs should not be distanced from the science base by becoming NSAs. Such a move would lessen Research Councils' ability to implement a coherent strategy for the support of science and technology, but would lead to no increase in the efficient and effective use of resources.**

45. We consider that mission statements provide an essential focus. Most, but not all, RCIs already have such mission statements.

**45.1 All RCIs should have a clear mission statement appropriate to and defining the institute's process and activity. The mission statement should be: specific, measurable, realistic and time-bound; set standards and lead to clear performance indicators; make clear the logic of who does what and where; and be endorsed by the staff collectively and individually.**

## Level Playing Field for all Contracts and Grants

46. The maintenance of research premises and the salaries of permanent staff in HEIs are currently provided from the UFC block grant, as part of the dual support system which also provides seed-corn research funding. Because of this division in responsibilities prior to payment, research in HEIs appears superficially to be cheaper than elsewhere. Other considerations would have to be taken into account but a step towards a truly level playing field would be to transfer to the Research Councils the resources and responsibilities for the research element of academic salaries and for the maintenance of premises that are attributable to research grants. Even then, however, the residual seed-corn funds and funds used in support of other customers (eg charities) would remain in the block grant as a resource which HEIs might choose to deploy to underpin contracts.

**46.1 Because we do not wish there to be a large perturbation of the HE system so soon after the recent shift in the dual support boundary, we do not recommend that there should at this stage be a transfer of funds in respect of premises and academic staff costs from the Funding Councils to the Research Councils. Such a transfer would, however, provide a route towards a level playing field and should be implemented as soon as practicable. In the meantime, the current Funding Council contribution should be displayed on all HEI research grants and contracts so that the full economic cost of the research is revealed.**

47. RCIs and HEIs are in competition with Government Research Establishments (GREs) and NSAs to provide the research required by Government Departments. Those Departments discharge their responsibilities in respect of policy set by Government which is itself a proxy customer acting in the public interest. For the internal market to operate effectively, there should be, as far as possible and given the background to which we refer above, a level playing field between all suppliers and this should be based on the recognition and payment of full economic costs (f.e.c.) on all contracts. Contractors will, however, wish to take into account the value of each contract to the long term capability of their organisation. Exceptions to the need for the payment and recovery of f.e.c. may occur when there is clear added value for the contractor through likely intellectual gains in respect of its mission or through synergy with an existing, fully funded project. But customers should normally expect to be charged f.e.c., and public sector contractors must be ready to make full account for any exceptions by reference to mission objectives.

**47.1 We affirm the principle that the full economic cost of research projects carried out in HEIs should be paid by all customers (charities, industry, Government Departments) thereby creating a level playing field within the HE system and between the HE system and other research providers including RC institutes, Government laboratories and industry.**

48. If a level playing field for Government R&D contracts is to exist across NSAs, GREs, RCIs and HEIs, then there must be "reciprocity". That is: Government



Departments must be as ready to place contracts with other laboratories - including RCIs and HEIs - as with their own agencies; and Research Councils will accept grant applications from Government laboratories and agencies where this is appropriate in furtherance of the aims and objectives of programmes to which the work of the agency is relevant. In all cases, consideration by the customer of the tender or application must be based on strict scientific criteria and on value to be gained, rather than on consideration of location alone.

48.1 All customers should be prepared to place contracts with any possible contractor, or give grants to any possible recipient, and must recognize that it is Government policy that HEIs and RCIs should secure full cost recovery.

48.2 GREs, NSAs and RCIs should be eligible to apply for research grants from the Research Councils. Cross-Council funding and Research Council funding of Government research laboratories should take place wherever it is appropriate in achieving strategic scientific objectives efficiently and effectively.

49. We note that NSAs are still closely tied to their parent Government Department and that many of them carry out underpinning basic research in support of their policy-led research activity, some of which is of the highest quality - and all of which should be subject to common review. We are concerned that such basic research is too remote from the activity of the science base to influence scientific development in HEIs and elsewhere.

49.1 There should be a review of the role and affiliations of the Government's scientific agencies. Government should consider whether some agencies, or some part of them, might be better placed under the aegis of the OST and within the strategic planning framework of the Research Council system (eg the Hadley Centre, the MAFF Fisheries Laboratory at Lowestoft, RSRE, TRRL and the Natural Resources Institute). This would lead to more effective dissemination of ideas and expertise across the publicly funded academic and research system. It would also lead to healthy competition in closely related areas of activity and areas of overlap.

## SUPPORT FOR RESEARCH IN HEIs AND RCIs

### Facilities

50. Central facilities are essential for the pursuit of certain kinds of research. They are usually housed in dedicated sites, such as SERC's Rutherford Appleton Laboratory, and are for the general use of the scientific community. The use and support of these facilities needs to be considered in the context of an international - and usually shared - network of publicly supported facilities which are funded in very different ways. Any evaluation of the financial efficacy of UK facilities

compared to those in other countries should therefore be interpreted against an appropriate backdrop.

**50.1 Facilities should be market tested, in the expectation that this will ensure the most effective use of resources. Options for new management systems, where necessary, should be identified and implemented as soon as possible.**

## European and International Relations

51. International collaboration in support of facilities and scientific programmes is essential if the UK is to be involved in the increasingly costly challenges at the frontiers of scientific discovery. International collaborations and commitments take many different forms: informal exchanges between individual scientists; global programmes coordinated by international bodies but funded through the coordination of national Research Council activities; bilateral agreements between the Research Councils and their opposite numbers abroad; multilateral enterprises dependent on international agreements; and EC programmes.

52. Informal collaborations between UK scientists and those in other countries are promoted by the Research Councils, the Royal Society and the Royal Academy of Engineering, and bodies such as EMBO. We affirm the value of these informal international links between scientists, but we note that sometimes these informal collaborations lead to proposals for formal collaborations. A guiding consideration in any international arrangements is that bureaucracy should be limited to the minimum required to maximise scientific benefits. Unless there is a clear gain from a formal arrangement, which exceeds the additional cost, formality will not add value to the science.

**52.1 Liaison between research teams in different countries should be encouraged as an important part of all scientific programmes, but should be left untrammelled so far as possible by additional bureaucratic structures.**

**52.2 Scientists should understand that it is the responsibility of the Research Councils, and ultimately of Government, to decide whether to fund international collaborative programmes after consideration of scientific priorities. A minimum level of bureaucracy for the administration of these schemes should always be an aim.**

53. There is a need to ensure the most efficient and effective deployment of research funds in formal international collaborations, particularly those that involve large investments in equipment, and to assess regularly the relative scientific priorities of both national and formal international programmes.

**53.1 The Cabinet Office guidelines should be used as a basis for the discussion of international collaborations between Research Councils and other groups. Particular care should be taken by the Councils to include, at**

**the outset of any negotiation, assessment procedures which match their own internal procedures, as well as possibilities for withdrawal. For collaborations already in place, the UK should press for full scientific evaluation at natural breakpoints in the work before further funds are committed.**

54. We believe that there is sufficient scope for the development of many national and international plans outwith the aegis of the EC. But, in the context of the European Community, there is also a need for improvements in quality control and more effective management. We further note that the deployment of supporting resources for recipients of EC grants is dealt with unevenly across Europe and to the apparent disadvantage of UK scientists and engineers; EC grants provide only marginal support and have to be reinforced by other funds drawn, for example, from UFC block grants.

## **MANPOWER**

### Postgraduates

55. Postgraduate education has many purposes and roles and it is unlikely that any system which is strongly dependent on one or a few routes through that education and training is providing the best service to either the student or the wider economy through which it is funded. The system of education which prepares graduates for research and further training has evolved considerably in recent years, but is perhaps now ready for more comprehensive development. We note that increasing numbers of undergraduate courses are evolving towards a (3+1) structure where the additional year is for only some students most of whom intend subsequently to specialise. At the same time, some postgraduate schemes have been evolving towards (1+3) where the preliminary year is a training preparation for research. There is, in our view, overlap between these schemes which might be rationalized to fit a more widespread (3+1+3) model in which the intermediate year has a distinctive value of its own.

**55.1 A year spent in formal Master's education should be the normal first step for students likely to benefit from additional training. This step should not be a token hurdle. The resultant qualification should be substantive, of value in itself and contribute to the judgment, not least by the student, of whether such training is desirable and, if so, what the nature of that training should be.**

56. Postgraduate education involves both a training element and a research element, and careful thought needs to be given to both the policy for and the funding of this level of education. The HEFCE has recently proposed that research students should be funded from the teaching element.



**56.1 There should be a transfer of resources from the Funding Councils to the Research Councils in respect of the research costs involved in the training of postgraduate research students. A careful analysis of these costs will be required before this transfer can be effected.**

57. A continuing anomaly in the funding of graduate students in HE is that additional funds are paid to the collegiate universities by the Research Councils in respect of the graduate student fees charged by their constituent colleges. This is an historic practice which has little relevance to the needs of modern scientific training; it is an inappropriate use of Science Budget funds; and it provides an unnecessary administrative burden.

**57.1 College fees in respect of postgraduate research students should no longer be paid to those collegiate universities which charge them. The resources involved should be transferred from the Research Councils to the HEFCs and allocated by the latter as appropriate to the universities concerned.**

### Professional Development

58. Highly skilled manpower is one of the most important outputs of the science base and has a pervasive benefit for society and the economy. We recognize that, in addition to the high-fliers who have the potential to be research leaders in industry, or in academia, scientific manpower includes a cadre of competent, highly skilled scientists who will become the "research officers" essential for the long-term support of research in any environment.

59. The personnel expansion in HEIs in the 1980s and '90s has been of research-only staff, of whom most are employed on short-term grants and contracts from the Research Councils, charities and industry. We are concerned that: there is at present no consideration given to long-term career development for these people; their existence, coupled with the desire to find them posts, contributes to pressure on research funding; and little responsibility is taken by HEIs for these staff or their future employment. We do not consider it desirable for researchers to be funded long-term on soft money.

60. Research Councils are not the employers of people employed on grants, but they are concerned with any effects on science funding and with the health of the science base, which may be adversely affected by low morale. We note that the Research Councils and the Royal Society have already set up Fellowship schemes in order to attract and support highly talented researchers.

**60.1 To ensure that the Research Councils gain the best results from their investment in research, they should seek assurances from HEIs about the effectiveness of their personnel policies.**

**60.2 The Research Councils should require HEIs to submit a short statement, when a grant is awarded, confirming:**

- that an RA is registered in the institution - with a central record of the grant(s) that the RA is, or has been, working on;
- details of the appraisal procedures and career counselling that will be provided for the RA - including when in the period of the grant these will be provided, and what form they will take;
- details of training to be provided - and to what professional qualification the training might lead;
- and, if the RA is to be registered for a higher degree, a brief outline of the distinction between the study and work programmes.

**60.3** Reciprocally, the Research Councils should collaborate with HEIs in the development of the research base through a variety of mechanisms, and should entertain proposals for the longer-term support of such research staff as have been identified, through appraisal and counselling, as having promise, either as research leaders or research officers. These judgements should also include consideration of the possible careers of these promising scientists in either academia or industry.

## **ADVISORY AND MANAGEMENT STRUCTURES**

61. The principal policy making body with the ultimate responsibility for publicly funded science and technology will continue to be a Cabinet Committee charged with that role, representing all relevant Departments of State and chaired by the Prime Minister. That body is underpinned by a committee of officials from the relevant Departments and chaired by the Government's Chief Scientific Adviser. The Government also requires appropriate advisory bodies. To make the implementation of our recommendations effective some of these bodies will need to take on new or strengthened roles and their purpose and interaction will need to be clarified, but we have sought to minimise the need for additional committees. The overall structure which would result if our recommendations were implemented is described in the ATTACHED FIGURES.

### Coordination

62. For there to be an effective national strategy for government research and development, it is essential that a mechanism be established for looking across Government activity in research and development. This is best done by strengthening the coordinating role of the existing official committee on science and technology and, possibly, by declaring that role in the committee's title.

## **62.1 We recommend the establishment of a Science and Technology Coordinating Committee (STCC).**

63. STCC would be chaired, as is the existing official committee, by the Chief Scientific Adviser and the secretariat would be provided by OST. The members would, again as now, include officials and senior figures engaged in publicly funded science including the Chief Scientists of Government Departments. The Chairman of the Board for the Research Councils (see paragraph 72.1) should also be a member and there should be specific provision for directors of research agencies, the heads of Research Councils and other key players from the Government research sector to attend as business required.

64. The committee would be concerned with the strategic issues of the pattern and balance of scientific activity in the UK and with harmonising and improving the planning and management of public sector science and technology and the interactions between the public and private sectors. It would be unrealistic for this committee to determine the disposition of funds among the science base and Government Departments; but Government Departments should display their forward plans for science expenditure and STCC decisions and recommendations should inform the planning of programmes suggested by policy considerations. STCC would advise the Chancellor of the Duchy of Lancaster and other Ministers on the balance and coordination of Government Departments' responsibilities in regard to science and technology.

### Advice

65. The Government needs independent advice on science and technology. This advice should be rooted in a high level of experience and expertise and independent of short-term policy considerations and the pressures of lobby groups and vested interests.

**65.1 Advice on the overall pattern of science and technology should be secured through a top-level Science and Technology Advisory Committee (STAC), reporting to the Prime Minister through the Chancellor of the Duchy of Lancaster. Both Ministers should periodically attend the committee.**

**65.2 STAC should have a visionary role and should operate with the minimum of bureaucracy.**

**65.3 STAC should identify problem areas and draw attention to opportunities in science and technology which are in danger of being overlooked.**

66. Ideally, STAC would have about eight independent members, including a Chairman, whose collective experience should cover both academic and industrial research, an awareness of the economy as it might be affected by research and the



need for highly trained manpower, and the full span of the sciences and of technology in the UK and elsewhere. Members should be ready to make a substantial time commitment. The Chief Scientific Adviser would be an Assessor to the committee and OST would provide the Secretary.

67. We would expect this committee to have a good understanding of where to go for expert advice and to develop an appropriate network of experts. The committee's recommendations would be pursued under the aegis of the Chief Scientific Adviser, either through the Science and Technology Coordinating Committee or through *ad hoc* groups. In some instances this could lead to the establishment of inter-agency committees to pull together the activities of a number of agencies on matters of common concern.

68. The Government has access to independent, unconstrained advice through the Royal Society, the Royal Academy of Engineering and the British Academy. These bodies and other academies are able to volunteer advice to Government and to carry out studies of science and technology issues.

### Government Departments

69. Government Departments need scientific competency and, in some instances, scientific establishments to enable them to carry out their functions and achieve their policy objectives. But the Government also needs to be able to obtain help and independent advice from those who are engaged in the research which underpins the work of the Departments, the wider public services and of the private sector. We recognize that most Government Departments have advisory systems, akin to the present ABRC, which help them to determine their priorities and the activities which best address those priorities. The advisory system is at present too opaque and there is insufficient wider understanding of how it operates.

**69.1 To aid understanding of the overall pattern of advice which lies behind the development of Government research and development, each Department should publish an explanatory review of its advisory structure, showing: the ways in which this leads to decisions about expenditure and about which programmes are supported; how the Department as proxy customer determines the needs of the ultimate customers; and the interaction between the Department and its contractors.**

**69.2 To exchange views and ideas, arrangements should be made for regular meetings of members of these Departmental science and technology advisory structures, under the chairmanship of the Chief Scientific Adviser.**

### The Research Council system

70. The benefits arising from investment in science and technology are characteristically long-term. We fully recognise and agree that policies for the

science base should be devised with proper regard for national needs, but it is essential that the advice and information from the science base should be free from short-term considerations of administrative and political convenience. If informed decisions are to be made about the assessment of relative scientific priorities, then programmes must be scrutinized and assessed by scientists of wide knowledge, much experience and a broad view of science and technology.

71. We discussed whether or not the Research Council system should be radically restructured as a series of operating divisions under a single, executive Board: a National Research Council (NRC). The ABRC has not agreed to recommend such a change, but we noted in our discussions that an important role would exist for the Chairman or Chief Executive of the NRC as the Accounting Officer on the management line between the Office of Public Service and Science and the heads of the research operating divisions.

72. The effective function of an advisory Board depends, on the other hand, on the use which is made of the advice which it provides. Well established mechanisms exist for the handling of the ABRC's formal Advice at the beginning of the Public Expenditure Survey, based upon the present Board's Forward Look exercise, and at the end of the PES cycle, when it advises the Chancellor on the allocation of the Science Budget among funded bodies; traditionally, the PES Advice is used as one part of the input which is made to Treasury on the size of the Science Budget while the Allocations Advice is generally taken in full. There are, by contrast, no established procedures by which the ABRC's conclusions on other science management issues are made binding on the Research Councils and other funded bodies.

**72.1 There should be a Board for the Research Councils which should provide independent advice to the Chancellor of the Duchy of Lancaster on scientific priorities and the balance of funding within the framework of Government's overall strategy on science and technology.**

**72.2 The Board for the Research Councils should normally transmit its conclusions, as formal Advice, to the Chancellor of the Duchy of Lancaster. Such advice should either be implemented by the management structure of OST or returned to the Board with a clear statement explaining why it cannot be accepted.**

**72.3 The Board should coordinate the scientific activities of the Councils, and be responsible for keeping under review the performance of the Councils against their missions. It should provide an Annual Report to the Chancellor of the Duchy of Lancaster, which should be brought before Parliament.**

**72.4 There should be regular meetings of the Board for the Research Councils with the Royal Society and the Royal Academy of Engineering to consider how they propose to spend their portions of the Science Budget and how they have spent it, and also meetings with these bodies and the**

**British Academy to consult them about science and technology issues in which they have an interest.**

**72.5 The Board should be responsible for close liaison with all the national Funding Councils, who would be represented individually at meetings when business required it.**

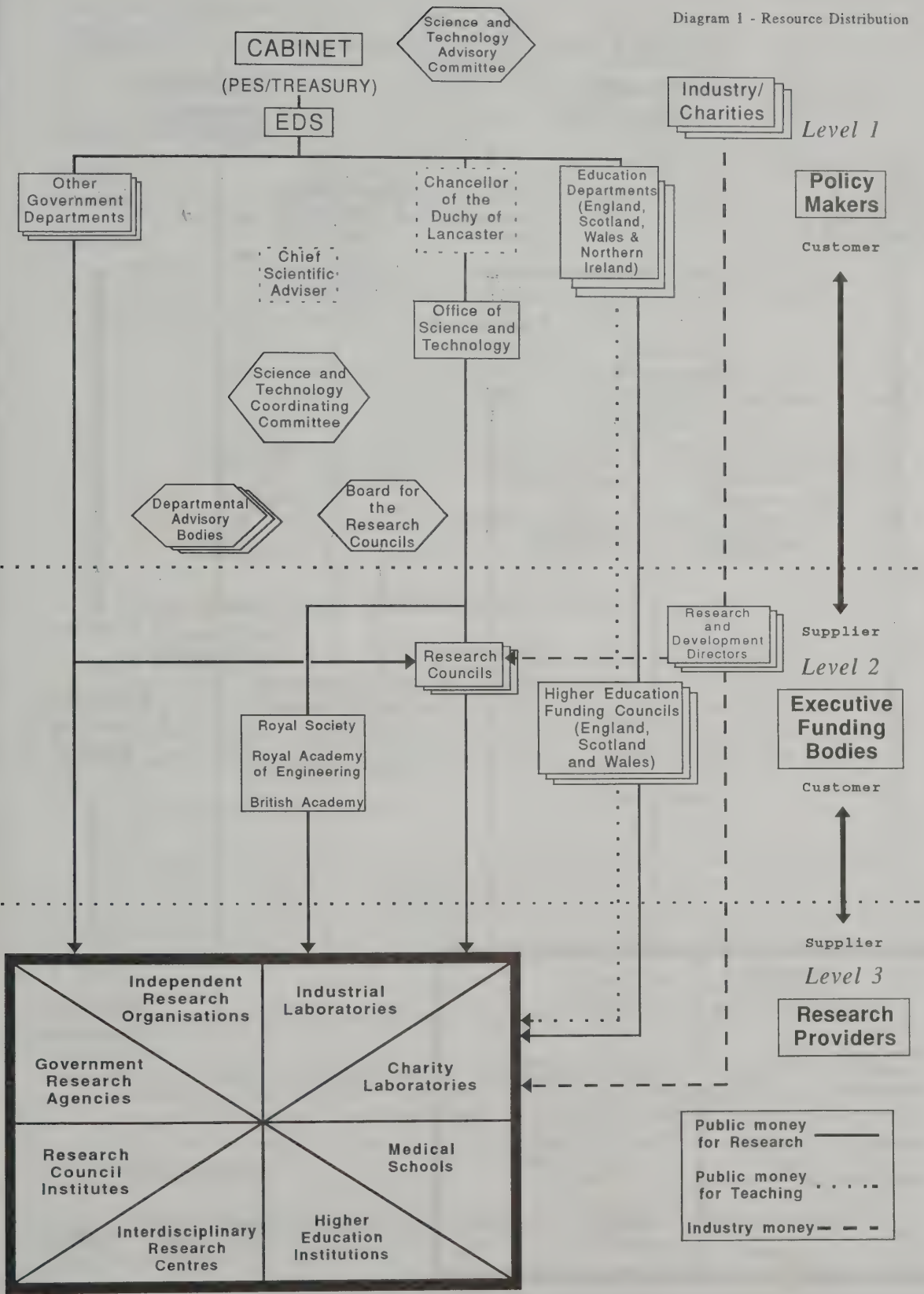
**72.6 The Board should follow the practice of the present ABRC in maintaining close liaison with the Chief Scientists of Government Departments through regular joint meetings to discuss scientific priorities, areas of common interest and the Departments' interface with the Research Councils.**

73. The Board should include: the heads of the Research Councils; a number of independent members; and a representative of the Funding Councils. The Chief Scientific Adviser should be an Assessor. The secretariat should be provided by the OST, ideally making use of staff seconded both from within the Civil Service and outside it. The Chairman should be a distinguished independent scientist or technologist. The number of representatives of industry and other users of research should balance those from academia. It is for consideration whether formal representatives of the Royal Society and Royal Academy of Engineering should be on the Board. The independent members should expect to devote substantial time to the Board (about one day per week) and should be given adequate secretariat support. Suggested terms of reference of the Board for the Research Councils are attached (ANNEX C).

**73.1 Consideration should be given to enlarging the scope of the Board, as a Board for Research, to reflect the wider responsibilities of the OST as they develop.**

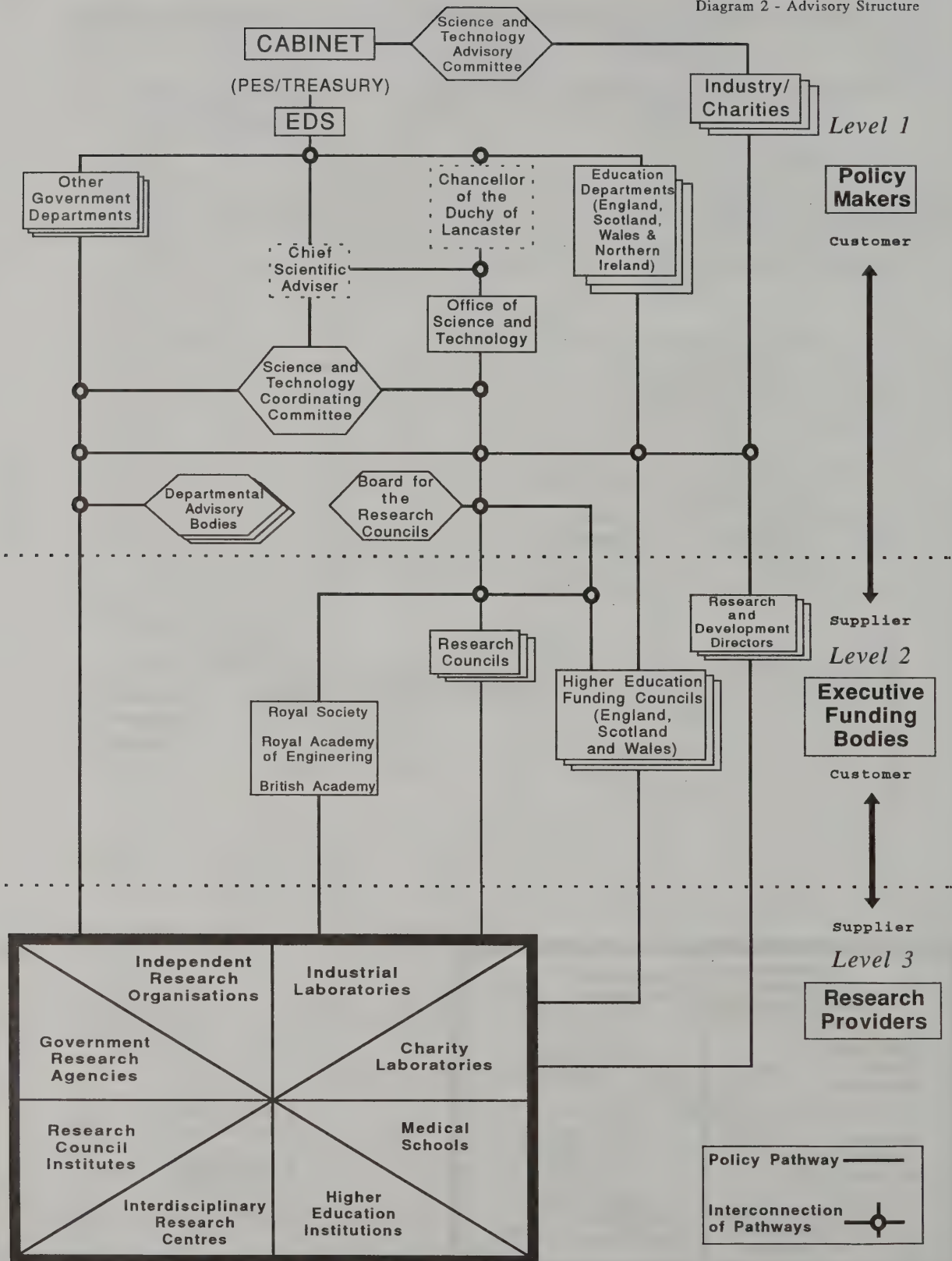


Diagram 1 - Resource Distribution



Note: The grouping on the extreme right hand side is a convenient, but not exclusive, means of classification. 27

Diagram 2 - Advisory Structure



Note: Information and advice should flow among all these bodies.

## MISSIONS

1. THE MISSIONS of the Research Councils should be clear and specific, and the nature of appropriate activity and performance measures should flow from the missions. The primary mission should be:

to respond to the UK's scientific needs by all appropriate means,  
so as to enhance economic well being and the quality of life.

2. Outline missions, which should be revised as appropriate by each Council in consultation with its scientific and user communities and with OST, are attached. Derived aims and objectives should include the following elements:

to respond to the UK's scientific needs by all appropriate means;  
to promote high-quality research;  
to develop and implement a strategy for manpower training;  
to facilitate the interaction between industries and research groups;  
to facilitate arrangements for the exploitation and application of  
research;  
to provide scientific knowledge and know-how for industry;  
to encourage good international relations between scientists.

### 3. Biology and Biosphere Research Council

to support high quality research into biological systems at all levels from the molecular to the ecological community which has as its ultimate objective the better employment of biological resources in support of economic competitiveness and the effective and efficient management of the natural and man-modified biological environment to enhance the quality of human life.

### 4. Geosphere Research Council

to support high quality research in the earth, atmospheric and ocean sciences which has as its ultimate objective the enhancement of environmentally appropriate development opportunities for natural global resources and the effective and efficient management of the natural physical environment to enhance the quality of life.

### 5. Astronomy and Particle & Nuclear Physics Research Council

to support high quality research in astronomy, planetary science, particle and nuclear physics, the ultimate objective of which is the enhanced fulfilment and long-term survival of the human species through improved understanding of the concepts and principles underlying physical phenomena and their consequences.

### 6. Physical and Engineering Sciences Research Council



to support high quality research in the physical and engineering sciences which has as its ultimate objective the improvement of human prosperity and the quality of life and the enhancement of industrial competitiveness through the development of new or mature technologies and techniques or through the solution of technological problems.

7. Medical Research Council

to support high quality research which has as its ultimate objective the maintenance and improvement of human health.

8. Social Sciences and Humanities Research Council

to support high quality social sciences and humanities research which has as its ultimate objective the enhancement of human potential and fulfilment, improving economic performance, maintaining social cohesion, improving governance and strengthening national and global security.

9. THE SCIENTIFIC RESPONSIBILITIES of the Research Councils would be:

Biology and Biosphere: the biological sciences currently supported by SERC (including biotechnology), the terrestrial and freshwater biological sciences currently supported by NERC and the research areas currently supported by AFRC.

Geosphere: the remainder of NERC's responsibilities (including oceanography, marine biology, atmospheric sciences, meteorology, hydrology, soil science, seismology, geomagnetism, geology, geophysics and geochemistry etc.) and SERC's current responsibilities for aspects of the above subjects at present within its remit, including Earth observation, archaeology, marine technology and coastal engineering;

Astronomy and Particle & Nuclear Physics: astronomy, planetary science, particle physics and nuclear physics currently supported by SERC;

Physical and Engineering Sciences: physical sciences, including chemistry, currently supported by SERC's Science and Materials Board; the physical and engineering sciences currently supported by SERC's Engineering and Technology Board; mathematics and computer science;

Medical Research: the current responsibilities of MRC;

Social Sciences and Humanities Research: the current responsibilities of ESRC, and responsibility for the support of research in the humanities.

## AIMS OF OTHER FUNDED BODIES

### 1. THE ROYAL SOCIETY

"The Royal Society is an independent learned society, self-governing under a Royal Charter, for the promotion of natural sciences, including mathematics and all applied aspects such as engineering and medicine. It encourages both national and international activities in a similar way to national academies overseas. Its objectives are:

- to encourage scientific research and its applications;
- to recognize excellence in scientific research;
- to promote international scientific relations and facilitate the exchange of scientists;
- to provide independent advice on scientific matters, notably to governments;
- to represent and support the scientific community;
- to promote science education as well as science understanding and awareness in the public at large;
- to support research into the history of scientific endeavour."

### 2. THE ROYAL ACADEMY OF ENGINEERING

"The object of the Royal Academy shall be the pursuit, encouragement and maintenance of excellence in the whole field of engineering to useful purpose in order to promote the advancement of the science, art and practice of engineering for the benefit of the public, and in pursuance of that object (but not further or otherwise) the Royal Academy shall have the following powers:-

- i to establish, uphold and advance proficiency in the practice of engineering in its various branches;
- ii to promote excellence in the education, training and experience of those engaged in engineering or related disciplines;
- iii to stimulate excellence and encourage creativity and innovation in engineering and in research, development and design in the manufacture of engineering products and in engineering services;
- iv to provide and exchange information on all branches of engineering and related subjects;

- v to give advice to Our United Kingdom Government or to any other body on matters concerning the overall practice of engineering;
- vi to co-operate and foster relations with other organisations and bodies whether cognate or not at home or overseas in pursuit of similar objects;
- vii to invite and collect subscriptions and donations of all kinds whether absolute or conditional for the purposes of the Royal Academy and to invest such subscriptions and donations as aforesaid and all other property of the Academy in the manner prescribed by the Statutes; and
- viii to do all such acts and things as shall further the attainment of the object of the Academy or the exercise of any of the powers hereby conferred upon it."



## BOARD FOR THE RESEARCH COUNCILS: TERMS OF REFERENCE

1. To advise the Chancellor of the Duchy of Lancaster on the health of the science base, and on his responsibilities for civil science - with particular reference to the Research Council system and its articulation with higher education, and the proper balance between national and international scientific activity.
2. To advise the Chancellor of the Duchy of Lancaster on the resource needs of the Research Councils, the Royal Society and the Royal Academy of Engineering, and on the allocation of the Science Budget between these bodies.
3. To promote productive interaction between the Research Councils and the users of the research which they support.
4. To promote effective collaboration between the Research Councils and the harmonisation of their activities, and to advise the Chancellor of the Duchy of Lancaster on any necessary transfers of responsibilities between Councils.
5. To keep under review the performance of the Councils against their missions.
6. To work closely with the Funding Councils on issues concerning the support of research in higher education institutions, and the training and support of postgraduate students.
7. To promote effective collaboration between Government Departments and Research Councils in the development of both their forward strategies, and in arrangements for commissioned research.











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